

**IN THE UNITED STATES DISTRICT COURT FOR
THE WESTERN DISTRICT OF WISCONSIN**

SSI TECHNOLOGIES, LLC,)	
)	
Plaintiff/Counterdefendant,)	Case No. 20-cv-00019
)	
v.)	Judge James D. Peterson
)	
DONGGUAN ZHENGYANG)	Magistrate Judge Stephen L. Crocker
ELECTRONIC MECHANICAL LTD.,)	
)	
Defendant/Counterplaintiff.)	
)	

**EXPERT REPORT OF JACK GANSSE ON INVALIDITY
OF U.S. PATENT NOS. 8,733,153 AND 9,535,038**

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I. Background and Experience

1. My name is Jack (legally John) Ganssle. I have been retained as an expert in this case by counsel for Dongguan Zhengyang Electronic Mechanical, Ltd.

2. I am the principal consultant of the Ganssle Group, a Maryland embedded systems consulting firm, and have worked in that capacity since 1997. I have consulted and continue to consult for a wide variety of companies developing embedded systems ranging from Fortune 100 companies and government entities, including the CIA, NSA and NASA, to small operations. The products these engineers design include practically everything electronic, from cellular phones to household appliances to weapon systems. After the space shuttle Columbia failed, NASA asked me to join their new Super Problem Resolution Team to address problems they needed help with. I was the only embedded person on that team.

3. In addition to consulting, I also teach on-site at companies, universities, organized public lectures, and at trade conferences. For example, from 2000 to 2002, I taught embedded systems courses to upperclassmen and graduate students in the Electrical Engineering Department at the University of Maryland. I also teach classes about embedded systems at conferences around the world, particularly The Embedded Systems Conference (in Boston, San Jose, Sao Paulo and Bangalore). Other keynotes include the CIISA in Guadalajara, ØREDEV in Malmo, Sweden, University of Tampere, Finland, John Deere Embedded Conference, Waterloo, IA, and IEEE section meetings. I have also given the keynote speech at several Embedded Systems Conferences.

4. I have authored over 1000 articles about embedded systems, software, and electronics. I have also authored and/or edited numerous books on embedded systems.

5. As my curriculum vitae (attached at Exhibit 1) details, I have extensive

experience in embedded systems design, analysis, and implementation relating to all aspects of embedded systems including architecture, hardware, software, system analysis, and developer support.

6. I believe my 45 years of experience in electronics and software, and particularly the embedded systems field, qualify me to render an accurate technical opinion regarding the technical issues in the litigation.

7. I am not an attorney. As such, my understanding of the relevant law is based on my prior experience and my discussions with Counsel. I am not offering any opinions on the law underlying my opinions.

II. Scope of Retention

8. I have been retained by Saul Ewing Arnstein & Lehr, LLP ("Counsel"), counsel for Dongguan Zhengyang Electronic Mechanical, Ltd. ("DZEM"), in connection with this matter. I have been asked to provide my opinions regarding the validity of the asserted claims of U.S. Patent No. 8,733,153 ("153 Patent") and U.S. Patent No. 9,535,038 ("038 Patent").

9. I am being compensation at a rate of \$350 per hour for my work performed on this matter. The compensation for work performed does not depend in any way on the outcome of this case or the opinions stated herein.

III. Information Considered

10. My opinions are based upon information available to me as of the date of this report. I have relied upon and examined documents produced by the parties along with publicly available information including, but not limited to:

- Patents and publications identified in claim charts appended to this opinion.
- The '153 Patent and prosecution history therefor.

- The '038 Patent and prosecution history therefor.
- Claim construction contentions of the parties.
- The complaint, first amended complaint, and second amended complaint related to this matter.
- The answer to the first amended complaint and answer to the second amended complaint related to this matter.
- The parties' interrogatory requests, responses, and supplemental responses.
- Other information cited within my report.

11. A listing of documents reviewed and considered to date in connection with this report is attached as Exhibit 2.

12. My opinions are based on my skills, knowledge, experience, education, and training, as well as information gathered by and/or provided to me as of the date of this report. It is usual and customary for experts to consider and/or rely upon sources of information such as those identified above and in Exhibit 2 in forming patent validity opinions.

13. References to documents and testimony herein are meant to provide examples of supporting information and are not intended to be comprehensive or exhaustive lists of all known support. The information in this report is based upon discovery to date and the information that is currently available.

14. To the extent any additional information is produced, it may become necessary to incorporate such additional information into my report, or otherwise to amend or supplement my report. I will be prepared to update my opinions if additional information becomes available that impacts my opinions and bases thereof.

15. I understand that I may be asked to offer testimony at trial regarding the opinions

described within this report. I may also be asked to testify at trial in rebuttal of testimony offered by SSI's expert. I expect to further elaborate and expand on the content of my report as necessary to make the testimony understandable to the Court. To the extent helpful to explain, or to put in context, the subject matters discussed throughout my report, I also expect to provide further general explanations of the matters I discuss. In connection with any testimony, I may rely on materials referenced in this report and in the attachments and exhibits of this report. I have not yet prepared demonstrative exhibits for use at trial as a summary of, or support for, the opinions expressed in this report, but I may do so in accordance with the pre-trial orders of the Court.

IV. Background of Case

16. The plaintiff in this case, SSI Technologies, LLC, is a company headquartered in Janesville, Wisconsin that produces various sensor devices, including pressure, level and magnetic sensors, digital pressure gauges, and digital level gauges for the automotive and industrial market. See <https://www.ssi-sensors.com/>.

17. The defendant in this case, DZEM, is a company that operates under the brand name KUS. The company is a global auto parts supplier integrating R&D, production, sales and service. DZEM provides solutions of SCR (Selective Catalytic Reduction) and ADAS (Advanced Driver Assistance Systems) for the transportation and industrial market. See kusauto.com. DZEM has branches in the United States, Mexico, the Netherlands, India, and China.

18. It is my understanding that SSI and DZEM are direct competitors for at least SCR solutions, and particularly a sensor used in DEF tanks.

A. The '153 Patent

19. One of the patents-in-suit is the '153 Patent. The '153 Patent is entitled Systems and Methods of Determining a Quality and/or Depth of Diesel Exhaust Fluid. It lists Lawrence

Reimer and Gregory Murphy as the inventors. The '153 Patent was filed on November 22, 2011 as Application Serial No. 13/294,866. The '153 Patent claims priority to U.S. Provisional Application Serial No. 61/412,667, which was filed on November 11, 2010.

20. It is my understanding from counsel and from SSI's responses to the interrogatory responses that claims 1, 2, 4, 7, and 8 of the '153 Patent are asserted. Claim 1 is the only asserted independent claim, and it requires, among other things, a controller configured to determine whether a contaminant exists in the fluid based on specific parameters. Claim 1 is reproduced below:

1. A system for determining a quality of a fluid in a tank, the system comprising:
 - a transducer configured to generate a sound wave and to detect an echo of the sound wave, the transducer positioned near the bottom of the tank such that the sound wave travels toward a fixed object, the fixed object positioned a known distance away from the transducer;
 - a temperature sensor configured to detect a temperature of the fluid; and
 - a controller configured to
 - produce a signal to drive the transducer to produce the sound wave,
 - receive an indication of the detected echo from the transducer,
 - receive an indication of the temperature of the fluid from the temperature sensor, and
 - determine whether a contaminant exists in the fluid based on the temperature of the fluid, a time period from when the sound wave is produced to when the echo is detected, and at least one of the group of a) whether a measured volume is out of range and b) a dilution of the fluid is detected while the measured volume of the fluid decreases.

21. I note that the '153 Patent includes several other independent claims directed to features other than contaminant detection. For the example, independent claim 11 and the claims depending therefrom relate to determining whether sound echoes are within a "near-field time" and less than a pre-determined threshold. Independent claim 21 and the claims depending therefrom relate to a system having two ultrasonic sensors, and also requires determining

whether sound echoes are within a "near-field time" and less than a pre-determined threshold. Independent claim 29 and the claims depending therefrom relate to a system for determining whether an error condition exists based on an incorrect calculated speed of sound through the fluid. Notably, dependent claim 30 determines that an error condition exists "based on a determined dilution of the fluid and a determined drop in a level of the fluid," and dependent claim 31 determines that an error condition exists "based on a determined level of the fluid exceeding a maximum limit."

22. In my review of the '153 Patent specification, I note that the only disclosure of any feature of a sensor being based on the concepts of a "determined dilution of the fluid" and a "determined drop in a level of the fluid" or a "determined level of the fluid exceeding a maximum limit" pertains, as claimed in claims 30 and 31, to detection of whether an error condition exists. See Col. 12, ll. 38-54. I further note that my review of the provisional application to which the '153 Patent claims priority (U.S. Provisional Patent Application Ser. No. 61/412,667 filed on November 11, 2010) reveals no teaching to a person skilled in the art of any sensor feature based on any of the concepts of a "determined dilution of the fluid" and a "determined drop in a level of the fluid" or a "determined level of the fluid exceeding a maximum limit". The first instance of such disclosures was in the non-provisional application (Ser. No. 13/294,886), which was filed on November 11, 2011.

23. Regarding the contaminant detection feature, the '153 Patent specification gives details regarding "the invention." The "invention uses immersed piezoelectric ultrasonic transducers ... to determine if the DEF has been contaminated (including determining the type and amount of contaminant)." '153 Patent, col. 1, ll. 36-41. The '153 Patent further explains that "[t]he controller also determines a concentration and presence of any contaminants in fluid in the

tank based on the elapsed time and the sensed temperature of the fluid." '153 Patent, col. 1, ll. 58-60. "It is possible for contaminants to become introduced into the tank (e.g., when filling the tank). ... Introduction of a contaminant into the tank 110 changes the speed of sound within the liquid 105, which is readily detected as either a shift in the UREA concentration level for small deviations, such as diluted UREA, or an out of range measurement for large deviations, such as would be the case with diesel fuel. ... The controller 400 can be configured to generate a diagnostic output, or out of range output signal, at output driver 420 whenever the measured speed of sound for a given temperature exceeds or falls below that which has been defined within the UREA concentration look-up table." '153 Patent, col. 9, l. 60 – col. 10, l. 26.

24. During prosecution of the '153 Patent, the examiner rejected claims 1 and 2 as filed finding that U.S. Patent Application Publication 2010/0018309 to Marcovecchio et al. ("Marcovecchio") rendered it obvious. The examiner found that "Marcovecchio et al. teaches a container having a fluid. Attached to the container is an ultrasonic transducer (reference item 20) that transmits at least one ultrasonic pulse to a target (reference item 40). The target can be fixed. The reflection of the ultrasonic pulse is received by the ultrasonic transducer. The speed of sound in the liquid (which can contain multiple liquids) as well as the liquid's temperature are determined. The speed of sound of the liquid is then determined as corrected by using a temperature measurement. Marcovecchio et al. uses the corrected speed of sound to determine the mixture ratio of the liquid. ... It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the teachings of Marcovecchio et al. in order to utilize the ultrasonic sensor to monitor the content of the fluid in a contain [sic] for the predictable result of being able to determine if a contaminant exists in the fluid. (U.S. Patent Appl. Ser. No. 13/294,866; Office Action dated 10/03/13).

25. With regard to claim 4, the examiner found this to be obvious in view of Marcovecchio and U.S. Patent Publication 2004/0173021 ("Lizon"). The examiner found that "Lizon et al. teaches that it's been known to modulate the frequency of an ultrasonic signal. The modulation allows improved responses to obtain a level of the fluid in a container. See at least paragraphs 35-39. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the teachings of Marcovecchio et al. with the teachings of Lizon et al. in order to perform some frequency modulation on the ultrasonic signal for the predictable [sic] benefit of improving the signal response." (U.S. Patent Appl. Ser. No. 13/294,866; Office Action dated 10/03/13).

26. With regard to claims 7 and 8, the examiner found these to be obvious in view of Marcovecchio and U.S. Patent 5,319,974 ("Lenz"). The examiner found that "Lenz et al teaches using an ultrasonic transducer to monitor the level of a fluid in a container. Lenz et al. teaches that the system is prone to detecting noise and false echoes. See at least column 10 (lines 14-29) where echoes that do not meet a specific time requirement are discarded. Lenz et al. also examines the amplitude of the received echoes to determine if they are valid. See at least column 10 (lines 30-57). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the teachings of Marcovecchio et al. with the teachings of Lenz et al. in order to evaluate the noise/echoes on a time basis for the predictable [sic] benefit of eliminating false echoes from the analysis." (U.S. Patent Appl. Ser. No. 13/294,866; Office Action dated 10/03/13).

27. In Applicant's response to the 10/03/13 Office Action, the Applicant argued about whether ethanol could be considered a contaminant. The Applicant argued that the Marcovecchio ethanol content measurement system is distinguishable from a contaminant detector because "[a]

contaminant is something other than the particular compound or item being measured." (U.S. Patent Appl. Ser. No. 13/294,866; Response to Office Action dated 12/23/13).

28. In addition, Applicant argued the claims, as amended, were distinguishable over Marcovecchio. Applicant argued "Marcovecchio, however, fails to disclose '[a] system for determining a quality of a fluid in a tank ... comprising: ... a controller configured to ... determine whether a contaminant exists in the fluid based on the temperature of the fluid, a time period from when the sound wave is produced to when the echo is detected, and at least one of the group of a) whether a measured volume is out of range and b) a dilution of the fluid is detected while the measured volume of the fluid decreases.' Marcovecchio determines a fluid mixture ratio based only on the temperature of the fluid and the time of flight of the ultrasound beam." (U.S. Patent Appl. Ser. No. 13/294,866; Response to Office Action dated 12/23/13) (emphasis in original). Based on the aforementioned amendment and arguments, claim 1 was allowed.

29. With regard to claims 2, 4, 7 and 8, the Applicant did not deny or otherwise dispute the findings of the examiner other than as stated above. (U.S. Patent Appl. Ser. No. 13/294,866; Response to Office Action dated 12/23/13).

30. My review of the '153 Patent specification shows only one disclosure of a situation where there is a dilution of fluid detected while the measured volume of the fluid decreases. (Col. 12, ll. 38-54). A plain reading of this teaching from the specification, however, demonstrates that it does not relate to a sensor's contaminant detection functionality. Instead, '153 Patent specification teaches that "[t]he sensor system 300 includes on-board diagnostic functions enabling it to detect failures of various components of the system 300. For example, the system 300 determines that there is an error when it detects the concentration level of the

UREA decreasing (i.e., becoming diluted) at the same time as the level of the UREA is decreasing. This can be caused when the speed of sound determined using the quality transducer 115 is slower than the actual speed of sound. When the system 300 determines that the UREA is being diluted, the calculated speed of sound increases. Because of the error in determining the speed of sound, it is possible that the tank 110 is being filled, causing the dilution of the UREA, but for the level determination to calculate that the level of UREA is actually decreasing. Because the UREA cannot become diluted when the level of the UREA is decreasing, the system 300 determines an error exists." ('153 Patent, col. 12, ll. 38-53). As is expressly stated in the specification, this disclosure is for detection of failures of various components of the system. There is no teaching that such a scenario is for contaminant detection, i.e., detection of something other than UREA.

31. As discussed above, the '153 Patent application (Application Serial No. 13/294,866) claims priority to U.S. Provisional Application Ser. No. 61/412,667. I understand that a patent claim may be afforded the benefit of the earlier filing date of a provisional application, and that this filing date may affect what may be considered as prior art, but only if the claim is supported by the disclosure of a provisional application. I have reviewed U.S. Provisional Application Ser. No. 61/412,667, and compared its disclosures with the asserted claim of the '153 Patent. Provisional Application Ser. No. 61/412,667 does not disclose all of the claimed limitations present in the asserted claims. For example, provisional application no. 61/412,667 does not teach any controller configured to make any determination regarding the presence of a contaminant based on whether a dilution of the fluid is detected while the measured volume of the fluid decreases as is claimed in claim 1 of the '153 Patent. As discussed, the earliest disclosure of a situation where there is fluid dilution detection while there is also

decreasing fluid volume is with Application Serial No. 13/294,866 filed on November 22, 2011. Thus, the provisional application does not include any disclosure of any sensor functionality based on whether fluid dilution is detected while fluid volume is decreasing, and claims including such a limitation are not supported by the provisional application. While Application Serial No. 13/294,866 and the specification for the '153 Patent does disclose some functionality based on the detection of fluid dilution while fluid level decreases, it is only for a system error condition check. The specification for the '153 Patent lacks any disclosure of contaminant detection based at all on based on the detection of fluid dilution while fluid level decreases. The first instance in which contaminant detection is described as being based on any of the concepts of a determined dilution of the fluid and a determined drop in a level of the fluid or a determined level of the fluid exceeding a maximum limit, was in the 12/23/13 response to an office action by way of a claim amendment. See U.S. Patent Appl. Ser. No. 13/294,866; Response to Office Action dated 12/23/13).

B. The '038 Patent

32. The other patent-in-suit is the '038 Patent, which is entitled Reduction of Aeration Interference in an Ultrasonic Fluid Sensing System, and lists Lawrence Reimer, Gregory Murphy, and David Schlenke as the inventors. The '038 Patent, which was filed on September 29, 2015 as Application Serial No. 14/868,910, is a division of Application Serial No. 14/044,444, which was filed on October 2, 2013.

33. It is my understanding from counsel and from SSI's disclosures that claims 9, 10, 11, 12, 13, and 18 are asserted. Claim 9 is the only independent claim asserted. Claim 9 is reproduced below:

9. A sensor operable to sense a characteristic of a fluid, the sensor comprising:
a sensing area configured to contain the fluid;

a chimney configured to exhaust entrapped air from the sensing area; and

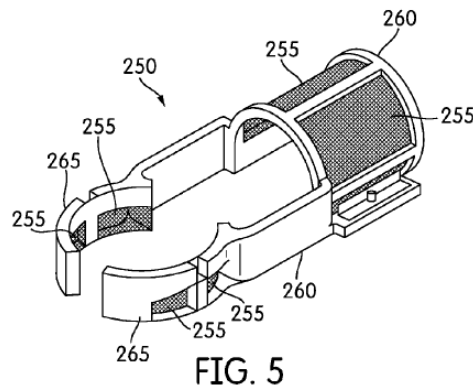
a filter covering the sensing area, the filter configured to allow a liquid portion of the fluid to enter the sensing area, and substantially prohibit one or more gas bubbles of the fluid from entering the sensing area; and

a transducer configured to output a pulse of sound through the liquid portion of the fluid contained within the sensing area, receive the reflected pulse of sound, and output a characteristic of the fluid based on the received pulse of sound.

34. Based on my review of the '038 Patent, a stated problem purportedly solved by the disclosed invention in the '038 Patent is to reduce the presence of bubbles in a sensing area of an ultrasonic sensor through use of a filter. For example, the specification states that "[g]enerally, accurate fluid measurements require a homogeneous fluid from which to measure the speed of sound. When the fluid is aerated the path of the ultrasonic sound waves are dispersed by the presence of air bubbles. This interference of the sound waves causes a loss in the reflected echo (i.e., no speed of sound measurement) and thus a loss of accurate fluid measurements. Accordingly, in one embodiment, the invention provides a filter, and more specifically, a fluid sensor including a filter. The filter blocks, or inhibits, air bubbles from entering a sensing area of the fluid sensor." '038 Patent, col. 1, l. 64 – col. 2, l. 7. The '038 Patent further states that "[i]f air bubbles are embedded within the fluid, the bubbles disperse the ultrasonic signal resulting in the fluid sensor not receiving the echo reflection, and thus no accurate time of flight measurement. These changes cause erratic measurement results or result in no measurement results." '038 Patent, col. 1, ll. 13-18.

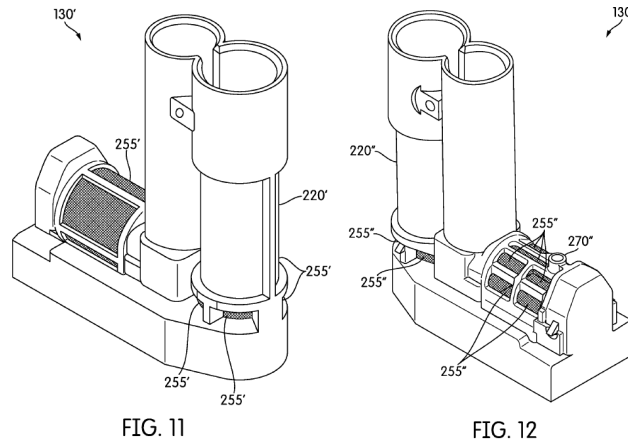
35. My review of the '038 Patent indicates that the only express embodiments of a filter in the specification or drawings is a mesh structure. The '038 Patent specification states: "FIG. 5 illustrates a filter, or filter shroud, 250 for prohibiting, or inhibiting, the flow of gas, such as but not limited to, gas bubbles (i.e., gas trapped in a liquid). In some embodiments, the filter 250 includes mesh, or one or more mesh screens, 255 and a frame 260. In other embodiments,

the filter 250 includes only the mesh screens 255. In some embodiments, the mesh screens 255 are a fine mesh material. In some embodiments, the mesh screens 255 are a synthetic polymer (e.g., nylon, polyethylene, polypropylene, etc.). In other embodiments, the mesh screens 255 are a metallic material." '038 Patent, col. 4, ll. 49-49.



"FIG. 11 illustrates another embodiment of a sensor system 130'. In the illustrated embodiment, the sensor system 130' includes one or more mesh screens 255'. The mesh screens 255' enclose the sensing areas (e.g., the measurement channel 205, the level sensing tube 220, etc.). In such an embodiment, the filter 250 includes only the mesh screens 255'. In the illustrated embodiment, the mesh screens 255' are integrated (i.e., molded) into a housing of the sensor system 130'."

FIG. 12 illustrates another embodiment of a sensor system 130". In the illustrated embodiment, the sensor system 130" includes one or more mesh screens 255" enclosing the sensing areas (e.g., the measurement channel 205, the level sensing tube 220, etc.) and a chimney 270". In the illustrated embodiment, the mesh screens 255" and chimney 270" are integrated (i.e., molded) into a housing of the sensor system 130". In such an embodiment, the chimney 270" operates as discussed above in relation to chimney 270. '038 Patent, Col. 5, l. 56 – col. 6, l. 6.



36. The '038 Patent further teaches that "the corollary to a particle is a gas bubble trapped within the fluid. The mesh screens 255 act to prevent the gas bubbles from entering into a sensing area (e.g., the measurement channel 205, the level sensing tube 220, etc.), while allowing liquid, or a liquid portion to enter the sensing area or sensing areas." The specification further states "[t]hus, the invention provides, among other things, a sensor systems including a filter for preventing gas bubbles from entering the sensor system." '038 Patent, col. 6, ll. 7-9.

37. In my review of the prosecution history, I note that the examiner stated in an office action that "[t]he specification recites that gas bubbles larger than the holes in the filter are prevented from entering the sensing area, but this prevention of gas bubbles still does not enable the phrase 'substantially prohibit a gas portion' as recited. Gas appears to be entrained in the liquid, such that if the liquid can pass through the holes in the filter, then the gas will pass as well because the gas molecules are smaller than the liquid molecules. Additionally, the phrase 'substantially prohibit' implies to the examiner that all of the gas is prohibited from entering the sensing area. It is not clear how the filter can prohibit all gas from passing through the filter, while still allowing the liquid to pass through. Again, this would only appear to work where gas bubbles are larger than the holes in the filter, but all other gases within the liquid would pass through the holes." (Appl. Serial No. 14/868,910, Office Action dated 4/6/16). I further note that

the applicant did not refute or otherwise clarify a meaning different from the examiner's stated understanding of "substantially prohibit" or how the claimed "filter" is taught to operate.

38. In response to the 4/6/16 Office Action, Applicant submitted new claims 12 - 21, which ultimately issued as claims 9 - 18 in the '038 Patent.

39. I have reviewed the specification and drawings of application serial no. 14/044,444 and found them to be identical to the specification and drawings of the '038 Patent. It is my understanding from Counsel that the earliest filing date to which the '038 Patent is entitled is October 2, 2013.

V. Summary of Opinions

40. It is my opinion that the asserted claims of the '153 patent are invalid as anticipated by or obvious in view of the prior art.

41. It is my opinion that the asserted claims of the '153 Patent are invalid for failure to enable a person of ordinary skill in the art to practice the full scope of the claimed inventions without undue experimentation.

42. It is my opinion that the asserted claims of the '153 Patent are invalid because the written description fails to demonstrate that the inventors possessed the invention as claimed at the time of filing of the application that matured into the '153 Patent.

43. It is my opinion that the asserted claims of the '038 Patent are invalid as anticipated by or obvious in view of the prior art.

44. It is my opinion that the asserted claims of the '038 Patent are invalid for failure to enable a person of ordinary skill in the art to practice the full scope of the claimed inventions without undue experimentation.

45. It is my opinion that the asserted claims of the '038 Patent are invalid because the

written description fails to demonstrate that the inventors possessed the invention as claimed at the time of filing of the application that matured into the '038 Patent.

46. It is my opinion that the asserted claims of the '038 patent are invalid as indefinite because its claims, when read in light of the specification, and the prosecution history, fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention.

47. It is my opinion that a person of ordinary skill in the art would need to have approximately 10 years of experience in sensor design, analog and digital circuits, and software and firmware development.

VI. Basis and Reasoning

48. As stated, I am not an attorney, and my understanding of the relevant law for my opinions was provided by Counsel and through my previous experience.

A. Claim Construction

49. It is my understanding that various invalidity issues, including anticipation, obviousness, lack of written description, and non-enablement, are premised on the construction of the patent claims at issue. It is my understanding that under the Court's procedures, the Court's determination of the meaning of the claim terms disputed by the parties will not take place until after the completion of my expert report. As such, I have considered both parties' current claim construction positions in my consideration of the issues in my report. To the extent that neither party has offered a definition of a claim term, I have applied the common ordinary meaning of those terms to a person of ordinary skill in the art.

50. Based on my review of papers exchanged by the parties, it is my understanding that the parties have proposed the following claim constructions for the '038 Patent.

Claim term	KUS Contention	SSI Contention
Chimney configured to exhaust entrapped air from the sensing area	opening adapted to permit air bubbles to exit the sensing area	a hollow structure extending vertically above the sensing area through which a gas, such as air, is permitted to pass, and configured to exhaust entrapped air from the sensing area
Filter	a porous structure defining openings, and configured to remove impurities larger than said openings from a liquid or gas passed through the structure	a device containing openings through which liquid is passed that blocks and separates out matter, such as air bubbles.
Covering	positioned between source of the fluid entering the sensing area and the sensing area	extending over and enclosing
Sensing area	the portion of the sensor through which the transducer's pulse of sound travels	area where the transducer's pulse of sound travels
Pulse of sound	a sound wave	Plain meaning and no further construction needed.
Transducer	a device that converts an electrical signal into sound waves and converts sound waves into an electrical signal	a device that converts an electrical signal into sound and converts sound into an electrical signal
Characteristic of the fluid	a feature or quality of the fluid, including at least concentration, level, or temperature	Plain meaning and no further construction needed.
Output a characteristic of the fluid based on the received pulse of sound	calculate and generate a value for a feature or quality of the fluid based on a characteristic of the pulse of sound	Plain meaning and no further construction needed. To the extent a construction is necessary, "produce a signal that represents a characteristic of the fluid based on the received pulse of sound."
Substantially prohibit one or more gas bubbles of the fluid from entering the sensing area	Indefinite	Plain meaning and no further construction needed.

51. I reserve the right to proffer my opinions regarding the proper meaning of the disputed claim terms at a later time.

52. It is my understanding that at the present time, the parties have not identified any disputed claim terms for the '153 Patent. Accordingly, I have afforded the terms the common ordinary meaning to a person of ordinary skill in the art. For purposes of this expert report, I have given the claim terms the common ordinary meaning to a person of ordinary skill in the art.

To the extent that I have used a claim meaning that is different from a common ordinary meaning, I have stated as such within my report.

53. One of the claim terms in the '153 Patent is "contaminant." The '153 Patent specification defines "contaminant" and "contamination" as "the introduction of a contaminant into the UREA and also the dilution of the UREA (e.g., the introduction of water)." However, during prosecution of the '153 Patent, the Applicant argued that Marcovecchio's ethanol content measurement system is distinguishable from a contaminant detector because "[a] contaminant is something other than the particular compound or item being measured." (U.S. Patent Appl. Ser. No. 13/294,866; Response to Office Action dated 12/23/13). The Applicant stated that Marcovecchio's teaching of measuring the content of ethanol in gasoline was not contaminant determination. The DEF liquid described in the '153 Patent, however, is a solution of urea¹ dissolved in purified water. See '153 Patent, col. 9, ll. 16-19.² It is inconsistent to say that the introduction of water is a contaminant when water is the liquid portion of DEF, and is the compound being measured.

B. Invalidity – Relevant Law

54. I have been informed that a duly issued patent is statutorily presumed valid, but that a patent may nonetheless be found invalid based on clear and convincing evidence. I have further been informed that "clear and convincing evidence" means that the evidence is highly and substantially more likely to be true than untrue; the fact finder must be convinced that the contention is highly probable.

¹ Urea, also known as carbamide, is an organic compound with chemical formula $\text{CO}(\text{NH}_2)_2$. See <https://en.wikipedia.org/wiki/Urea>

² Diesel exhaust fluid (DEF; also known as AUS 32 and marketed as AdBlue) is a liquid used to reduce the amount of air pollution created by a diesel engine. Specifically, DEF is an aqueous urea solution made with 32.5% urea and 67.5% deionized water. DEF is consumed in selective catalytic reduction (SCR) that lowers the concentration of nitrogen oxides (NO_x) in the diesel exhaust emissions from a diesel engine. See https://en.wikipedia.org/wiki/Diesel_exhaust_fluid

55. Anticipation – Relevant Law. I have been informed that a patent claim is invalid due to anticipation if every element of the claimed invention is expressly or inherently contained within a single prior art document. I have further been informed that with apparatus claims, which all of the asserted claim are, can be anticipated by or obvious in view of a prior art apparatus that is reasonably capable of performing the claimed functions.

56. Obviousness – Relevant Law. It is my understanding that a patent claim may be invalid as obvious if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. I further understand that there must be some reason that a person of ordinary skill in the art would have combined the art to arrive at the claimed invention. I further understand that one should consider any secondary considerations of non-obviousness, such as commercial success attributable to the claimed invention and industry accolades, if in evidence.

57. I have been informed that the references discussed in my report are prior art to the patent in suit to which they are applied. Unless otherwise stated herein, I offer no opinions regarding whether any of the cited reference are prior art or not.

58. Non-enablement – Relevant Law. It is my understanding that a patent's specification must contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains to make and use the same. I further understand that in order for a patent application to be enabling, the patent specification must teach those skilled in the art how to make and use the full scope of the claimed invention without undue experimentation, and that the relevant time for this is as of the patent's effective filing date. In addition, whether any

experimentation is "undue" relates to: the quantity of experimentation necessary, the amount of direction or guidance presented in the specification, the presence or absence of working examples in the specification, the nature of the invention, the state of the prior art, the relative skill of those in the art, the predictability or unpredictability of the art, and the breadth of the claims.

59. Written Description – Relevant Law. I understand that the test for the written description requirement is whether the original specification shows that the inventor actually invented the invention claimed. I have been informed that the "original specification" is the information included in the original patent application, including the specification, original claims, and drawings. I have further been informed that for the written description analysis, the knowledge of ordinary artisans may be used to inform what is disclosed in the specification, but it cannot to teach limitations that are not in the specification, even if those limitations would be rendered obvious by the disclosure in the specification.

60. Indefiniteness – Relevant Law. I have been informed that patent claims can be found invalid for indefiniteness, and that a patent must be precise enough to afford clear notice of what is claimed and apprise the public of what is still open to them. I understand that a claim is invalid for indefiniteness if its language, read in light of the specification and prosecution history, fails to inform, with reasonable certainty, those skilled in the art about the scope of the invention.

C. Invalidity '038 Patent – Prior Art (Anticipation and Obviousness)

61. It is my opinion that under SSI's proposed claim constructions each of the asserted claims of the '038 Patent are invalid as anticipated. The detailed basis for my anticipation opinions is set forth in the claims charts appended to my report.

62. It is my opinion that under SSI's proposed claim constructions Claim 9 is anticipated by U.S. Patent Application Publication No. 2011/0228641 ("Niemann"). Niemann discloses a sensor operable to sense a fluid characteristic, namely, its level. The Niemann sensor includes a sensing area configured to contain the fluid, and a chimney configured to exhaust entrapped air from the sensing area. Covering the sensing area is a filter, as "filter" is defined by SSI. As shown in my claim charts, the Niemann sensor includes a device containing openings through which liquid is passed, and that blocks and separates out matter, such as air bubbles. This "filter" in Niemann is configured to allow a liquid portion of the fluid to enter the sensing area, and substantially prohibit one or more gas bubbles of the fluid from entering the sensing area. The Niemann sensor includes an ultrasonic transducer configured to output a pulse of sound through the liquid portion of the fluid contained within the sensing area. Consistent with SSI's infringement contentions, the Niemann transducer receives a reflected pulse of sound, and outputs a characteristic of the fluid based on the received pulse of sound.³ It is my further opinion that at least claims 10-13 and 18 of the '038 Patent are also invalid as anticipated by Niemann under SSI's claim constructions. See attached claim charts for additional information related to my opinions.

63. It is my opinion that under SSI's proposed claim constructions Claim 9 is anticipated by U.S. Patent Application Publication No. 2012/0152015 ("Beyer"). Beyer discloses a sensor operable to sense a fluid characteristic within the meaning of characteristic as indicated in the '038 Patent, namely, fluid level. The Beyer sensor includes a sensing area configured to contain the fluid, and a chimney configured to exhaust entrapped air from the sensing area.

³ It should be noted that for purposes of this report, I have assumed, unless otherwise stated, similar to SSI's infringement contentions, that a transducer is capable of outputting a characteristic of the fluid based on the received pulse of sound. I do not agree, however, a transducer is capable of such functionality.

Covering the sensing area is a filter, as "filter" is defined by SSI, which is configured to allow a liquid portion of the fluid to enter the sensing area, and substantially prohibit one or more gas bubbles of the fluid from entering the sensing area. It is notable that Beyer further teaches that use of fine-mesh structure to keep air bubbles outside of the measuring chamber was known in the art, but suffers from disadvantages not present in the "filter" of Beyer (at least according to SSI's definition of "filter"). The Beyer sensor includes an ultrasonic transducer configured to output a pulse of sound through the liquid portion of the fluid contained within the sensing area. Consistent with SSI's infringement contentions, the Beyer transducer receives a reflected pulse of sound, and outputs a characteristic of the fluid based on the received pulse of sound. It is my further opinion that at least claims 10-13 and 18 of the '038 Patent are also invalid as anticipated by Beyer. See attached claim charts for additional information related to my opinions.

64. It is my opinion that under SSI's proposed claim constructions Claim 9 is anticipated by U.S. Patent No. 5,456,108 ("Birkett"). Birkett discloses a sensor operable to sense a characteristic of a fluid, namely, fluid level. The Birkett sensor includes a sensing area in a stillwell configured to contain the fluid, which corresponds to the claimed filter under SSI's definition of "filter." The stillwell has an open upper end to vent gas, which corresponds to the claimed chimney. The stillwell is configured to allow a liquid portion of the fluid to enter the sensing area, and substantially prohibit one or more gas bubbles of the fluid from entering the sensing area. The Birkett sensor includes an ultrasonic transducer configured to output a pulse of sound through the liquid portion of the fluid contained within the sensing area. Consistent with SSI's infringement contentions, the Birkett transducer receives a reflected pulse of sound, and outputs a characteristic of the fluid based on the received pulse of sound. Claims 10-13 and 18 are also invalid as anticipated by Birkett. See attached claim charts for additional information

related to my opinions.

65. Claim 9 of the '038 Patent is also invalid as anticipated by Japanese Publication JP4842728B2 ("Satoyuki")⁴. Satoyuki discloses an ultrasonic concentration and velocity measuring device. An ultrasonic transducer is configured to generate a sound pulse through a ultrasonic propagation area, which is the sensing area. A gas distribution cylinder, which corresponds to the filter, is fixed on the pipe body and allows a liquid part of the fluid to enter the ultrasonic propagation area, while preventing air bubbles from entering the ultrasonic wave propagation region 24. The ultrasonic transceiver is configured to output sound pulses and cause them to pass through a fluid portion within the ultrasonic propagation region, receive the reflected pulses of sound, and output the characteristics of the fluid based on the received sound pulses. Satoyuki discloses outlet slits, which define vertical passages, through which entrapped gas may exit, and correspond to the claimed chimney. See claim charts for additional information related to my opinions.

66. It is my opinion that Claim 9 of the '038 Patent is invalid, under DZEM's proposed claim construction for "filter" because it is obvious in view of either of Niemann or Birkett in combination with either of China Patent Publication CN202381147 ("Gu") or Japan Patent Publication JP2004317288 ("Koji"). The relevant disclosures of Niemann and Birkett, were discussed above and in the claim charts, and are incorporated here. To the extent that the claim term "filter" is construed as a porous web for removing impurities from a liquid or gas passed through it, the mesh structure disclosed in Gu or the permeable structure in Koji would meet this limitation. Substituting the mesh structure from Gu or the permeable structure in Koji for the stillwell arrangements of either Niemann or Birkett would be a matter of substitution of a

⁴ For any non-English documents, I have relied on a translation provided to me by counsel.

known structure for prohibiting bubbles, and would thus be obvious. Moreover, use of the mesh structure of Gu or the permeable structure of Koji is simpler and less expensive than the stillwell arrangement of Niemann and Birkett, and thus a person of ordinary skill in the art would be motivated to use the mesh or permeable membrane structures to simplify construction. Claims 10-13 and 18 are also invalid as obvious in view of Niemann or Birkett in combination with Gu or Koji as well. See attached claims charts for additional information related to my opinions.

67. Claim 9 of the '038 Patent is also invalid as obvious in view of Koji in combination with Gu. Koji discloses an ultrasonic velocity measurement device and specifically discloses a sensor 50 for detecting fluid, and includes an ultrasonic transceiver, which corresponds to the transducer. The ultrasonic wave propagation region 1 corresponds to a sensing area. The permeable material 4 corresponds to the claimed filter according to DZEM's proposed definition of "filter." The permeable material 4 allows the liquid portion of said fluid to enter said ultrasonic wave propagation region 1 and prevent air bubbles in the fluid from penetrating into the ultrasonic wave propagation region. The ultrasonic transceiver outputs sound pulses and cause them to pass through the liquid portion of the fluid, receives sound reflection pulses, and outputs the characteristics of the fluid based on the received sound pulses. Koji also discloses slits that permit any entrapped gas bubbles in the sensing area to exit the sensing area.

Alternatively, if Koji's slits are not considered to be a chimney under SSI's proposed construction of "chimney," I conclude that a chimney configured to exhaust entrapped air from the sensing area is found in Gu. Gu discloses a filter device 40 of the liquid level sensor and an air vent 103, which corresponds to a chimney, and which is connected to the filter chamber 102. Any entrapped gas is discharged outward through the vent 103. One of ordinary skill in the art would be motivated to include a vent because it is common knowledge that gas dissolved in a liquid in a

sensing area may degas due to temperature or pressure changes or microbubbles may coalesce into larger bubbles, and that to exhaust this gas, one would include a vent. Therefore, including the chimney of Gu with Koji would have been obvious to one having ordinary skill in the art. Claims 10-13 and 18 are also invalid as obvious. See claims charts for additional information related to my opinions.

68. I further conclude that Claim 9 of the '038 Patent is obvious in view of Japan Patent JP4842728 ("Satoyuki") in combination with Gu. Satoyuki discloses an ultrasonic concentration and velocity measuring device. An ultrasonic transducer is configured to generate a sound pulse through an ultrasonic propagation area, which is the sensing area. A gas distribution cylinder, which corresponds to the filter, is fixed on the pipe body and allows a liquid part of the fluid to enter the ultrasonic propagation area, while preventing air bubbles from entering the ultrasonic wave propagation region 24. The ultrasonic transceiver is configured to output sound pulses and cause them to pass through a fluid portion within the ultrasonic propagation region, receive the reflected pulses of sound, and output the characteristics of the fluid based on the received sound pulses. Satoyuki discloses outlet slits through which entrapped gas may exit, which constitute a chimney. Under SSI's construction of "chimney," and to the extent that Satoyuki does not disclose a chimney configured to exhaust entrapped air from the sensing area, I conclude that Gu discloses a filter device 40 of the liquid level sensor and an air vent 103. This air vent corresponds to a chimney, connected to the filter chamber 102 under either SSI's or DZEM's proposed claim construction. Any entrapped gas is discharged outward through the vent 103. A person of skill in the art would have a reason to combine the vent with the gas distribution cylinder because it is common knowledge that gas dissolved in a liquid in a sensing area may degas due to temperature or pressure changes, or bubbles may form due to

disturbances or coalescing, and that it is desirable to exhaust this gas to prevent degradation of the sound pulse. Therefore, including the chimney of Gu with Satoyuki would have been obvious to one having ordinary skill in the art. Claims 10-13 and 18 are also invalid as obvious. See claim charts for additional information.

69. I conclude that Claim 9 of the '038 Patent is also invalid as obvious in view of U.S. Patent 5,319,973 ("Crayton") in combination with Koji. Crayton discloses a fluid level sensing device. Crayton discloses a sensor operable to sense a characteristic of a fluid, namely, fluid level. The sensor comprises a sensing area in the level sensing tube to contain the fluid. Crayton further discloses a chimney in the form of the top of the level sensing tube, to exhaust entrapped air from the sensing area is provided. An ultrasonic transducer is provided which outputs a pulse of sound through the liquid portion of the fluid contained within the sensing area, receives the reflected pulse of sound, and according to SSI's purported definition of transducer, outputs the level of the fluid based on the received pulse of sound. Crayton does not disclose a filter covering the sensing area. As discussed, it is well-known in the art that existed at the earliest filing date for the '038 Patent that bubbles in a sensing area interfere with ultrasonic pulses, and that it is desirable to minimize or eliminate such bubbles. Koji teaches the use of a mesh or permeable medium configured to allow a liquid portion of the fluid to enter the sensing area, and substantially prohibit one or more gas bubbles of the fluid from entering the sensing area. Thus a person of ordinary skill in the art would be motivated to use the mesh or permeable membrane structures at the inlet hole for the level sensing tube. Claims 10-13 and 18 are also invalid as obvious in view of Crayton in combination with Koji as well. See claim charts for additional information.

70. With regard to my obviousness position and the possibility of secondary

considerations, I am unaware of any secondary considerations of non-obviousness. I reserve the right to supplement my opinions should any such evidence be presented.

D. Invalidity '038 Patent – Non-enablement

71. Based on my review of the '038 Patent, I conclude that the asserted claims are invalid as being non-enabled for several reasons.

72. Claim 9 of the '038 Patent is invalid as being non-enabled for the full scope of the claim. The claim states that the transducer is configured to output "a characteristic of the fluid based on the received pulse of sound." Dependent claim 12 states that the sensed characteristic may be concentration, level or temperature. As such, the outputting of temperature based on the received pulse of sound is within the scope of claim 9. However, the '038 Patent specification provides no disclosure sufficient to enable a person of ordinary skill in the art to sense the temperature of the fluid with a pulse of sound without undue experimentation. Rather, the only disclosure for determining a temperature of the fluid is with a temperature sensor, such as a thermistor, thermocouple, resistance temperature sensor, or an infrared temperature sensor.

73. In my opinion, substantial experimentation would be required to develop, if it is possible at all, a system that utilizes a sound pulse to determine the temperature of fluid where the composition of the fluid is subject to change, and the distance traveled by the sound pulse is not necessarily fixed, because there are too many variables. In addition, there is no guidance provided at all in the '038 Patent specification as to how one could determine fluid temperature based on a pulse of sound. For at least these reasons, the amount of experimentation necessary to make and use the claimed invention to determine fluid temperature based on a sound pulse would be undue, if it is possible at all. Each of asserted claims includes this limitations. Accordingly, each of claims 9, 10-13 and 18 are invalid as non-enabled.

74. In addition to the lack of enablement for determining the fluid characteristic of temperature based on a received pulse of sound, the claim term "characteristics" is broad enough⁵ to require an enabling disclosure for determining other properties of the fluid based on the pulse of sound, such as viscosity, pH, density, but the '038 Patent lacks any corresponding teachings for these types of properties. Except for claim 12, each of the other asserted claims – 9, 10, 11, 13, and 18 – claim "characteristics" broadly so as to include any of the aforementioned fluid properties, but lack any disclosure that would enable a person of skill in the art to output any of these properties without undue experimentation. Similar to the experimentation necessary to develop a sensor capable of determining temperature based on a pulse of sound, the amount of experimentation necessary to develop a sensor capable of determining any of the aforementioned fluid properties would be undue, if it were possible at all, due to the number of unknown variables and the complete lack of any guidance provided in the '038 Patent specification.

75. Each of the asserted claims includes the claim limitation that the claimed sensor senses and outputs a characteristic of the fluid based on a "pulse of sound." The claim term sound is much broader than ultrasound. For example, "sound" includes frequencies that are not ultrasonic, such as auditory waves and infrasound waves. Ultrasound is understood as sound with a frequency of approximately 20 Kilohertz (20,000 Hz) or above. By contrast, infrasound is understood to cover sounds 20 Hz down to 0.1 Hz, and auditory sound are the frequencies in between the ultrasound and infrasound ranges. The specification, fails to provide any teaching as to how one would sense and output characteristics of a fluid based on either infrasound waves or auditory sound waves, and to do so would require undue experimentation. The stated intended

⁵ I note that SSI has taken the position that the common ordinary meaning of "characteristics" should apply. "Characteristic" commonly means a property or quality of something, see, e.g., <https://www.merriam-webster.com/dictionary/characteristic>.

use for the invention in the '038 Patent is for a diesel exhaust mitigation system. Infrasound sensors are used for seismic and atmospheric events.⁶ There is no explanation in the '038 Patent for how a sound pulse in the infrasound range could be used to determine fluid level or fluid concentration. If it would even be possible, the amount of experimentation necessary to make a DEF sensor using infrasound would be undue. Similarly there is no teaching in the '038 Patent for how a sound pulse in the auditory range could be used to determine fluid level or fluid concentration. If it would even be possible, the amount of experimentation necessary to make a DEF sensor using a sound pulse in the auditory range would be undue.

76. It is my further opinion that the asserted claims are also invalid because the specification fails to enable a person of skill in the art to practice the full scope of the claimed "transducer" element. A transducer is a device that transforms a signal from one energy from another energy form. Both parties appear to agree on this definition. The claimed "transducer" is required to "output a characteristic of the fluid based on the received pulse of sound." The '038 Patent fails to enable a person of ordinary skill in the art to have the transducer output any fluid characteristics. The '038 Patent specification describes using a printed circuit board to analyze the data from the sensors and output the analyzed data to other components, and differentiates the printed circuit board from the transducer. With regard to the fluid characteristics of concentration and level, the '038 Patent states that the transducer generates an acoustic wave signal and then a time-of-flight of the acoustic signal is output to the sensor control system, which is part of the printed circuit board. The only teaching in the '038 Patent of anything being output by the transducer is of a sound pulse and time-of-flight data. Neither of these are a fluid characteristic. They are also not even representative of a fluid characteristic. The sound pulse

⁶ See e.g., <https://technology.nasa.gov/patent/LAR-TOPS-106>; <https://sensorsandtransducers.wordpress.com/2012/02/21/infrasound/>

output by a transducer is nothing more than sound energy pulse and is completely independent from the medium through which the sound pulse is emitted. The time-of-flight data is, as the name implies, merely an indication of the amount of time for a sound pulse to travel to a reflective surface and return. By itself, this time-of-flight data does not represent any fluid characteristic. Moreover, the '038 Patent specification lacks any teaching where the transducer outputs a fluid characteristic, and to do so would require undue experimentation. A sound transducer, by its nature, is an input/output device that converts an electrical signal to a mechanical sound pulse. In some cases, the transducer may also be able to receive a mechanical sound pulse and convert that into an electrical signal. In that a transducer is simply incapable of performing calculations, the experimentation necessary to have it do so would be undue. It is further notable that if one were to connect a processor of any sort to the transducer, it is the processor, not the transducer that would be performing any calculations.

77. Each of the asserted claims is also invalid as non-enabled because a person of ordinary skill in the art would not be able to practice the full scope of the invention without undue experimentation, because such a person would be unable to have a filter that "substantially prohibit[s] one or more gas bubbles of the fluid from entering the sensing area" as is expressly claimed in claim 9, and by implication in the other asserted claims.⁷ The '038 Patent specification teaches that bubbles of a certain size, which are smaller than the aperture size of the mesh screens, are able to freely pass through the mesh screens. Moreover, the '039 Patent states that empirical testing shows that an aperture size of 100 microns "*reduces the quantity* of gas bubbles within the sensing area sufficiently enough to enable continuous measurements" by the sensor. '038 Patent, Col. 5, ll. 7-17 (emphasis supplied). The claims, however, include no

⁷ As is discussed elsewhere in my report, the phrase "substantially prohibit one or more bubbles" makes no sense and is indefinite.

limitation as to the aperture size of the claimed "filter." There is no teaching of the aperture size necessary to substantially prohibit one or more bubbles. It is known in the art that bubbles can be substantially smaller than the 100 micron size discussed in the '038 Patent specification, e.g., 10 microns. As such, bubbles of this size could pass through the mesh described in the specification. There is also no explanation regarding what size bubble may or may not negatively affect an ultrasonic sound pulse. While, theoretically, one could reduce the size of the holes in the mesh, at some point, the ability to allow liquid to flow through the filter would be negatively affected, and the balance of allowing a liquid portion through while substantially prohibiting one bubble would require substantial and undue experimentation. Accordingly, I conclude that a filter that "substantially prohibit[s] one or more gas bubbles of the fluid from entering the sensing area" is not enabled by the specification and would require undue experimentation.

78. It is my opinion that Claim 11 of the '038 Patent is invalid as non-enabled for an additional reason. Claim 11 recites a filter that is "configured to disperse one or more gas bubbles to produce a homogeneous fluid entering the fluid channel, prohibit one or more gas bubbles from entering the sensing area, or both." See '153 Patent, claim 11. The '038 Patent specification fails to teach one of skill in the art to practice the invention as claimed. The common meaning of "disperse" that is applicable here, in my opinion, is "to cause to break up."⁸ While the '153 Patent includes no disclosure of a filter configured to disperse gas bubbles, this definition is consistent with the only uses of the word "disperse" in the specification. See, col. 1, l. 54 – col. 2, l. 18 ("Generally, accurate fluid measurements require a homogeneous fluid from which to measure the speed of sound. When the fluid is aerated the path of the ultrasonic sound waves are **dispersed** by the presence of air bubbles. This interference of the sound waves causes

⁸ See e.g., <https://www.merriam-webster.com/dictionary/disperse>.

a loss in the reflected echo (i.e., no speed of sound measurement) and thus a loss of accurate fluid measurements. Accordingly, in one embodiment, the invention provides a filter, and more specifically, a fluid sensor including a filter. The filter blocks, or inhibits, air bubbles from entering a sensing area of the fluid sensor. The sensing area contains the fluid to be sensed. The fluid is sensed by generating an ultrasonic pulse wave through the fluid contained within the sensing area. The time of flight of the ultrasonic pulse wave travelling the distance of the sensing area and returning to the output point is measured. If air bubbles are embedded within the fluid, the bubbles **disperse** the ultrasonic signal resulting in the fluid sensor not receiving the echo reflection, and thus no accurate time of flight measurement. These changes cause erratic measurement results or result in no measurement results.") (emphasis added). With regard to the term "homogeneous," the only use of this word in the '038 Patent specification is from the same passage: "Generally, accurate fluid measurements require a **homogeneous** fluid from which to measure the speed of sound. When the fluid is aerated the path of the ultrasonic sound waves are dispersed by the presence of air bubbles." Id. As such, the common definition for "homogeneous" – "of uniform structure or composition throughout"⁹ – is appropriate in my opinion. Moreover, a "homogenous fluid" is taught to be non-aerated, i.e., without air bubbles. The sentence structure of the claim indicates that the claimed filter must be configured in one of three ways: (1) to disperse bubbles to produce a homogeneous fluid; (2) to prohibit one or more gas bubbles from entering the sensing area¹⁰; or (3) both to disperse bubbles to produce a homogeneous fluid and to prohibit one or more gas bubbles from entering the sensing area. Presumably, #1 and #2 are different since they are claimed as being different. There is no

⁹ see <https://www.merriam-webster.com/dictionary/homogeneous>

¹⁰ Per the discussion above, Claim 9 requires that the filter "substantially prohibits one or more bubbles," which the patent examiner interpreted as "all of the gas is prohibited from entering the sensing area", and which the applicant did not dispute.

explanation, however, regarding how #1 and #2 are different, or how a filter “disperses” bubbles to make a “homogenous” fluid, prohibits one or more bubbles from entering the sensing area, or both of these, as is claimed. For example, there is no teaching in the '038 Patent specification of a filter that breaks up bubbles. Claim 11 is further invalid as non-enabled in that the specification fails to enable fluid entering a “fluid channel” by failing to disclose what the “fluid channel” is, or even mention “fluid channel” in the specification. The “fluid channel” cannot be the same thing as the “sensing area” since this is a different term. It is my understanding that because the filter of claim 11 depends from claim 9, claim 9 necessarily includes within its scope what is recited in claim 11, and as such, claim 9 of the '038 Patent is invalid as non-enabled for the reasons discussed with respect to claim 11.

E. Invalidity '038 Patent – Lack of Written Description

79. It is my opinion that each of the asserted claims of the '038 Patent are invalid for lack of written description.

80. Claim 9 of the '038 Patent is invalid under 35 U.S.C. § 112 as lacking written description. The claim states that the transducer is configured to output “a characteristic of the fluid based on the received pulse of sound.” Dependent claim 12, which is also asserted by SSI, specifies that the sensed characteristic may be selected from the group of concentration, level or temperature, and therefore the claim term “characteristics” in claim 9 necessarily includes at least these fluid characteristics. The '038 Patent specification, however, provides no written description for outputting a temperature of the fluid based on a received pulse of sound. Rather, the only disclosure for determining a temperature of the fluid is with a temperature sensor, such as a thermistor, thermocouple, resistance temperature sensor, or an infrared temperature sensor. There is no indication in the original specification that the inventors were in possession of a

sensor that was able to determine temperature based on a sound pulse. In addition, the claim term "characteristics" of the fluid is also broad enough to include things such as viscosity, density, and pH level. The '038 Patent specification fails to provide any written description for determining any such characteristics as is broadly claimed, or any indication that the inventors possessed such a sensor. In that each of claims 10-13 and 18 includes the same limitation, claims 10-13 are also invalid for lacking written description.

81. Claim 9 is also invalid because the specification fails to provide written description for the claimed "pulse of sound" element. The '038 Patent specification only discloses use of an ultrasonic wave, which is understood in the art to have a frequency greater than 20 kHz. The claim to a "pulse of sound" would include other sound frequencies less than 20 kHz, such as auditory waves and infrasound waves, and there is nothing in the written description to suggest that SSI had possession of such an invention at the time of filing. In that each of claims 10-13 and 18 includes the same limitation, claims 10-13 are also invalid for lacking written description.

82. It is my further opinion that the asserted claims of the '038 Patent are invalid for lack of written description based on SSI's asserted definition of "filter." SSI contends that "filter" is defined as "a device containing openings through which liquid is passed that blocks and separates out matter, such as air bubbles." SSI appears to have carefully crafted its interpretation of filter so that the size of the holes in the device are not necessarily what keeps air bubbles out of the sensing area. In other words, unlike DZEM's definition, which requires that it is the size of the holes being smaller than the air bubbles that prevents air bubbles from entering the sensing area, SSI's proposed definition for filter is written in such a way that bubbles may be smaller than the holes in the device, but that the device still keeps the bubbles out of the sensing area. As

discussed above, the only teaching in the '038 Patent of a "filter" is one that uses mesh that has openings that are smaller than the bubbles it is keeping out of the sensing area. While I understand that claims are not necessarily limited to the preferred embodiment, no embodiment is taught that uses any structure that has holes large enough to allow bubbles through, yet prevents bubbles from entering the sensing area by some other means. I am aware of devices that do include holes larger than air bubbles, and that prevents the bubbles from entering a sensing area. Examples of such devices are discussed with my opinions regarding the invalidity of the asserted claims of the '038 Patent based on the prior art, including, Niemann, Beyer, and Birkett. I further note that SSI itself has another patent, U.S. Pat. No. 10,012,121, that prevents bubbles from entering a sensing area by some means other than having holes that are of a size that prevents bubbles larger than those holes from entering the sensing area. The '038 Patent specification, however, only teaches preventing bubbles from entering a sensing area through a barrier with holes of a size that prevents bubbles larger than the holes from passing through. There is no indication in the original application that the inventors possessed anything else. As such, if SSI's proposed claim construction is to be applied, claim 9 of the '038 Patent is invalid as lacking written description. In that each of claims 10-13 and 18 includes the same limitation, claims 10-13 are also invalid for lacking written description.

83. The asserted claims of the '038 Patent are also invalid for lack of written description because the specification lacks any teaching to demonstrate that the inventors were in possession at the time of filing of the claimed "transducer" element. As discussed, the parties agree that a transducer is a device that transforms a signal from electrical energy to sound energy, and from sound energy to electrical energy. The claimed "transducer" is required to "output a characteristic of the fluid based on the received pulse of sound." The '038 Patent

specification does not teach that the transducer outputs any characteristic of the fluid. Instead, the '038 Patent specification describes using a printed circuit board to analyze the data from the sensors and output the analyzed data to other components, and clearly describes the printed circuit board as a different component from the transducer. The '038 Patent specification fails to demonstrate that the inventors possessed a transducer that is capable of determining a characteristic of the fluid and outputting it. There is also no teaching in the specification to suggest that a transducer is even capable of outputting a fluid characteristic, such as concentration, level, or temperature. In that each of asserted claims includes this limitation, all of the asserted claims are invalid for lack of written description.

84. Each of the asserted claims is invalid for lack of written description because the specification lacks any teaching to demonstrate that the inventors were in possession at the time of the invention of a filter that "substantially prohibit[s] one or more gas bubbles of the fluid from entering the sensing area." The '038 Patent specification recognizes that bubbles of a certain size, which are smaller than the aperture size of the mesh screens, are able to freely pass through the mesh screens. The claims, however, state that the claimed invention substantially prohibits one gas bubble. The specification fails to demonstrate that the inventors possessed the invention as claimed at the time of the filing of the application, and instead, the invention prohibited gas bubbles of a certain size from entering the sensing area. My reasoning from my non-enablement opinions are incorporated by reference here.

85. Claim 11 of the '038 Patent is invalid for lack of written description. Claim 11 claims a filter configured to disperse one or more gas bubbles to produce a homogeneous fluid entering the fluid channel, prohibit one or more gas bubbles from entering the sensing area, or both. The written description fails to demonstrate that the inventors possessed, at the time of

filing, a filter that configured to disperse one or more gas bubbles to produce a homogeneous fluid entering the fluid channel and/or prohibit one or more gas bubbles from entering the sensing area. Claim 11 is further invalid for lack of written description in that the written description fails to demonstrate that the inventors possessed, at the time of filing, a filter that disperses gas bubbles to produce a homogeneous fluid entering a fluid channel by failing to disclose any "fluid channel." I recognize that originally filed claim 3 includes the limitation of a "filter ... configured to disperse one or more gas bubbles to produce a homogenous fluid entering the fluid channel, prohibit one or more gas bubbles from entering the sensing area, or both." Nonetheless, the complete lack of any teaching in the specification of a filter that both disperses gas bubbles to produce a homogenous fluid entering a fluid channel, whatever that is, and prohibits one or more gas bubbles from entering the sensing area demonstrates that the inventors were not in possession of such a device. In that the "filter" of claim 1 is necessarily within the scope of the filter of claim 9, claim 9 of the '038 Patent is invalid as non-enabled and for lack of written description because dependent claim 11 is non-enabled and lack written description. My reasoning from my non-enablement opinions are incorporated by reference here.

F. Invalidity '038 Patent – Indefiniteness

86. It is my opinion that the asserted claims of the '038 Patent are invalid as indefinite. Based on my reading of the '038 patent, including, the claims, specification, and drawing, as well as the prosecution history for the '038 patent, I conclude that the claims fail to inform with reasonable certainty those skilled in the art about the scope of the invention, and particularly, what is meant by a filter that "substantially prohibit[s] one or more gas bubbles of the fluid from entering the sensing area." This limitation is found in each of the asserted claims, either expressly or by dependency. According to the plain interpretation of the claim, the claimed

filter must (a) substantially prohibit one gas bubble of the fluid from entering the sensing area, and (b) also substantially prohibit more than one bubble of the fluid from entering the sensing area. In my opinion, this language lacks the required reasonable certainty as to the particular function of the claimed filter, in that "substantially prohibit one ... bubble" makes no sense. One bubble is either prohibited from entering the sensing area, or it is not. It cannot be substantially prohibited.

G. Invalidity '153 Patent – Prior Art (Anticipation/Obviousness)

87. It is my opinion that claims 1, 2, 4, 7, and 8 of the '153 Patent are invalid as either anticipated or obvious in view of the prior art.

88. Claims 1 and 2 of the '153 Patent are invalid as anticipated by U.S. Patent No. 9,151,736 to Frivik ("Frivik"), which is based on PCT application no. PCT/NO2010/000481 filed on December 21, 2010, and was first published June 30, 2011. I have been informed that the Frivik reference is prior art to the '153 Patent. Each of the claimed limitations of claims 1 and 2 of the '153 Patent are disclosed in Frivik or capable of being performed by the device disclosed in Frivik. The specific disclosures of Frivik are set forth in my claim charts.

89. Claims 1 and 2 of the '153 Patent are also invalid as anticipated by U.S. Patent No. 8,583,387 ("Murphy"). I have been informed that the Murphy reference is prior art to claims 1 and 2 of the '153 Patent. The specific disclosures of Murphy are set forth in my claim charts.

90. Claims 1 and 2 of the '153 Patent are also invalid as anticipated by German patent reference DE 10 2009 055 738 A1 ("Bertow"). I have been informed that the Bertow reference is prior art to the '153 Patent. I have been provided with an English translation of Bertow provided to me by counsel in the form of the U.S. counterpart to Bertow, namely, U.S. Patent Application Publication 2013/0074590. The references in my claim charts are to the U.S. counterpart. Each

of the claimed limitations of claims 1 and 2 of the '153 Patent is disclosed in Bertow or capable of being performed by the device disclosed in Bertow. The specific disclosures of Bertow are set forth in my claim charts.

91. Claims 1 and 2 of the '153 Patent are also invalid as anticipated by U.S. Patent No. 7,775,092 ("Murphy/Weber"). I have been informed that the Murphy/Weber reference is prior art to the '153 Patent. Each of the claimed limitations of claims 1 and 2 of the '153 Patent is disclosed in Murphy/Weber or capable of being performed by the device disclosed in Murphy/Weber. The specific disclosures of Murphy/Weber are set forth in my claim charts.

92. Claims 1 and 2 of the '153 Patent is also invalid as obvious in view of the combination of Frivik with Murphy. Frivik discloses a float to determine fluid level. Substituting the float with an ultrasonic level sensor, as is disclosed in Murphy would have been a simple substitution of known elements. A person would have been motivated to utilize the ultrasonic level sensing of Murphy in the Frivik system so as to be able to determine that a fluid level reading is greater than the fluid tank size for the reasons discussed in Murphy.

93. Claims 1 and 2 of the '153 Patent are also invalid as obvious in view of the combination of Bertow with Murphy. While Bertow is capable of determining whether a sensed fluid level exceeds a known tank size, and therefore anticipates claim 1, a person of ordinary skill in the art would have been motivated to combine the express teaching from Murphy of determining whether a sensed fluid level exceeds a known tank size to further enhance determination of the presence of contaminants.

94. Claims 1 and 2 of the '153 Patent are also invalid as obvious in view of the combination of Murphy with Murphy/Weber. The disclosures of Murphy/Weber are provided in my attached claim charts. Murphy/Weber does not expressly disclose determining whether a

sensed fluid level is "out of range," i.e., exceeds a known tank size. See, '153 Patent, col. 11, ll. 29-41. It would have been obvious to a person of ordinary skill in the art to have incorporated this feature from Murphy, and would have been motivated to do so to further enhance determination of the presence of contaminants.

95. Claim 4 is invalid as anticipated by Frivik. Claim 4 is also invalid as obvious in view of Frivik in combination with Murphy. Claim 4 is also invalid as obvious in view of Frivik in combination with Bertow. Claim 4 is also invalid as obvious in view of any of Frivik, Murphy, or Bertow in combination with U.S. Patent 6,573,732 ("Reimer"). I have been informed that Reimer is prior art to the '153 Patent. The specific disclosures are set forth in my claim charts. A person of ordinary skill in the art would have been motivated to include the modulation of Frivik or Reimer to improve the quality of the echo for the reasons taught in Frivik and Reimer.

96. Claim 7 is anticipated by Murphy. Claim 7 is also obvious in view of Frivik in combination with either Murphy or Bertow. A person of ordinary skill in the art would have been motivated to include the validity criteria claimed in claim 7 to reduce false readings.

97. Claims 7 and 8 are invalid as obvious in view of any of Frivik, Murphy, or Bertow in combination with Reimer or U.S. Patent 5,319,974 ("Lenz"). Claims 7 and 8 are invalid as obvious in view of Murphy in combination with Murphy/Weber and Reimer or Lenz. A person of ordinary skill in the art would have been motivated to include the determination of whether a detected echo is valid based on a predetermined time limit or predetermined range from Reimer or Lenz to minimize false readings.

98. With regard to my obviousness position and the possibility of secondary considerations, I am unaware of any secondary considerations of non-obviousness. I reserve the right to supplement my opinions should any such evidence be presented.

99. I note that none of the aforementioned prior art discloses contaminant detection based on a determination that dilution is detected while fluid level decreases as is claimed in claim 1 of the '153 Patent. While no explanation of contaminant detection based on this scenario is present in the '153 Patent specification, and instead, the '153 Patent specification very clearly states that such a situation is not possible,¹¹ a hypothetical scenario where this could happen may be where someone is filling the DEF tank with water while the urea solution is also being drained from the tank, and the rate of filling is less than the draining rate. It is my opinion that any of Frivik, Bertow, or Murphy/Weber would be capable of detecting and outputting information indicating that a fluid level is decreasing while fluid dilution is also detected.

H. Invalidity '153 Patent – Non-Enablement

100. It is my opinion that claim 1 of the '153 Patent is invalid as non-enabled.

101. One of the claim limitations requires determining whether a contaminant exists in a fluid based in part on whether a dilution of the fluid is detected while the measured volume of the fluid decreases. The '153 Patent specification, however, lacks any teaching of a sensor system for determining whether a contaminant exists in a fluid based in part on whether a dilution of the fluid is detected while the measured volume of the fluid decreases. Instead, the '153 Patent teaches that a fluid cannot become diluted when the level of the fluid is decreasing, and that if the sensor system determines such an event an error condition is determined. See '153 Patent, col. 12, ll. 38-53. The '153 Patent explains that the error condition is present where there is a failure of one or more components of the system. However, the claimed sensor of claim is not for system error detection, it is for contaminant detection, which as stated, is not taught in the '153 Patent specification. To the contrary, the '153 Patent actually teaches that "UREA cannot become

¹¹ "Because the UREA cannot become diluted when the level of the UREA is decreasing, the system 300 determines an error exists." ('153 Patent, col. 12, ll. 38-53).

diluted when the level of the UREA is decreasing" unless there is a system error, i.e., the system is not able to determine the presence of contaminants. Therefore, claim 1 of the '153 Patent is invalid for non-enablement. This same limitation is found in claims 2, 4, 7 and 8, which are also invalid as non-enabled for the reasons discussed with regard to claim 1.

102. Claim 1 of the '153 Patent is further invalid as being non-enabled for failure to enable a person of ordinary skill in the art to practice the full scope of the invention in that claim 1 utilizes a "sound wave" to determine whether a contaminant exist, while the specification only enables use of sound within the ultrasonic range. As with the '038 Patent, the '153 Patent specification discloses only use of an ultrasonic transducer. The claim term "sound wave" is much broader than ultrasound. For example, "sound" includes frequencies that are not ultrasonic, such as auditory waves and infrasound waves. Ultrasound is understood as sound with a frequency of approximately 20 Kilohertz (20,000 Hz) or above. By contrast, infrasound is understood to cover sounds 20 Hz down to 0.1 Hz, and auditory sound are the frequencies in between the ultrasound and auditory sound ranges. The '153 Patent expressly recognizes that the term "sound wave" is broader than sound within the ultrasonic range by claiming in claim 2 that the "transducer produces an ultrasonic sound wave." '153 Patent, claim 2. If "sound wave" was limited to an ultrasonic sound wave, then claim 2 would be redundant. The specification, however, fails to provide any teaching as to how one would sense and output characteristics of a fluid based on either infrasound waves or auditory waves, and to do so would require undue experimentation. The stated intended use for the invention in the '153 Patent is for a diesel exhaust mitigation system. Infrasound sensors are used for seismic and atmospheric events. There is no explanation in the '153 Patent for how a sound pulse in the infrasound range could be used to determine fluid level or fluid concentration. If it would even be possible, the amount of

experimentation necessary to make a DEF sensor using infrasound would be undue. Claims 4, 7, and 8 are similarly invalid as non-enabled for this reason. With regard to claim 2, the claim requires that "the transducer produces an ultrasonic sound wave." This does not appear to narrow the scope of claim 1 in that claim does not limit the sound wave to an ultrasonic sound wave, such as by stating that the sound wave is in the ultrasonic range. Claim 2 still recites determining whether a contaminant exists based on "a time period from when the sound wave is produced to when the echo is detected. Accordingly, claim 2 is also non-enabled.

103. Claim 1 of the '153 Patent is also invalid as non-enabled because the specification fails to teach how to determine the presence of a contaminant using a transducer positioned near the bottom of a tank that emits a sound wave towards a fixed object. The only teaching of a transducer positioned near the bottom of a tank emitting a sound wave to a fixed object is as shown in Fig. 1. As discussed above, the Applicant explained during prosecution of the '153 Patent that a "contaminant" is something other than what is being measured, which would include things such as diesel fuel. The specification teaches, however, that contaminants, such as diesel fuel, will stratify within the tank. As such, even if a contaminant such as diesel fuel is in the DEF tank, the diesel fuel will form a layer separate from the DEF. Since diesel fuel is less dense than the urea solution, it will be in a layer above the sensing area, and not be detected. This same limitation is found in claims 2, 4, 7 and 8, which are also invalid as non-enabled for the reasons discussed with regard to claim 1.

I. Invalidity '153 Patent – Lack of Written Description

104. It is my opinion that claim 1 of the '153 Patent is invalid for lack of sufficient written description. The original application for the '153 Patent fails to demonstrate that the inventors possessed a sensor system that was capable of determining whether a contaminant

exists in a fluid based in part on whether dilution of the fluid is detected while the measured volume of the fluid decreases. The '153 Patent explains that the error condition is present where there is a failure of one or more components of the system. See '153 Patent, col. 12, ll. 38-53. However, the claimed sensor of claim is not for system error detection, it is for contaminant detection, which as stated, is not taught in the '153 Patent specification. To the contrary, the '153 Patent actually teaches that "UREA cannot become diluted when the level of the UREA is decreasing" unless there is a system error, i.e., the system is not able to determine the presence of contaminants. See '153 Patent, col. 12, ll. 38-53. As such, there is no indication that the inventors possessed a contaminant detector that based this detection on whether dilution of the fluid is detected while the measured volume of the fluid decreases, and therefore, I conclude that claim 1 is invalid for lack of written description. This same limitation is found in claims 2, 4, 7 and 8, which are also invalid for lack of written description enabled for the reasons discussed with regard to claim 1.

105. Claim 1 of the '153 Patent is invalid for lack of written description because it fails to demonstrate that the inventors possessed a system that utilizes a "sound wave" other than one within the ultrasonic range to determine whether a contaminant exists. The '153 Patent specification only discloses use of an ultrasonic wave, which is understood in the art to have a frequency greater than 20 kHz. The claim to a "sound wave" would include other sound frequencies less than 20 kHz, such as auditory waves and infrasound waves. The '153 Patent expressly recognizes that the term "sound wave" is broader than sound within the ultrasonic range by claiming in claim 2 that the "transducer produces an ultrasonic sound wave." '153 Patent, claim 2. If "sound wave" was limited to an ultrasonic sound wave, then claim 2 would be redundant. There is nothing in the written description to suggest that SSI had possession at the

time of filing of the claimed sensor using the broad "sound wave" as is claimed . This same limitation is found in claims 4, 7 and 8, which are also invalid for lack of written description enabled for the reasons discussed with regard to claim 1. With regard to claim 2, the claim requires that "the transducer produces an ultrasonic sound wave." This does not appear to narrow the scope of claim 1 in that claim does not limit the sound wave to an ultrasonic sound wave, such as by stating that the sound wave is in the ultrasonic range. Claim 2 still recites determining whether a contaminant exists based on "a time period from when the sound wave is produced to when the echo is detected. Accordingly, claim 2 is also invalid as lacking sufficient written description.

VII. Conclusion

106. It is my conclusion that each of the asserted claims of the '153 patent is invalid as anticipated by or obvious in view of the prior art.

107. It is my conclusion that each of the asserted claims of the '153 Patent is invalid for failure to enable a person of ordinary skill in the art to practice the full scope of the claimed inventions without undue experimentation.

108. It is my conclusion that each of the asserted claims of the '153 Patent is invalid because the written description fails to demonstrate that the inventors possessed the invention as claimed at the time of filing of the application that matured into the '153 Patent.

109. It is my conclusion that each of the asserted claims of the '038 Patent is invalid as anticipated by or obvious in view of the prior art.

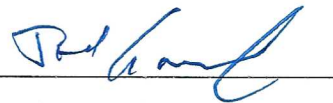
110. It is my conclusion that each of the asserted claims of the '038 Patent is invalid for failure to enable a person of ordinary skill in the art to practice the full scope of the claimed inventions without undue experimentation.

111. It is my conclusion that each of the asserted claims of the '038 Patent is invalid

because the written description fails to demonstrate that the inventors possessed the invention as claimed at the time of filing of the application that matured into the '038 Patent.

112. It is my conclusion that each of the asserted claims of the '038 Patent is invalid as indefinite because the claims, when read in light of the specification, and the prosecution history, fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention.

Dated: January 22, 2021



Jack Ganssle